



Study Material for Training on

Integrated Pest and Disease Management in Chili

Introduction:

Farming of vegetables including chili plays an important role in agriculture economy. This provide more income and employment than cereal and staple crops as well as healthy foods because of high vitamins and essential micro-nutrients. This crop has high economic value because it is needed for daily dietary as well as for raw material of food and pharmaceutical industries. Chili farming in particular has been able to revitalize rural economy through increase in farmers' income, agricultural marketing and employment. Chilies are valued for their soothing effects on the digestive system, relief from symptoms of cold, sore throats and fever. Chilies can act as heart stimulant, which regulates blood flow and strengthens the arteries possibly reducing the heart attacks. Medicinally, capsaicin is used to alleviate pain. It is most recommended topical medication for arthritis.

Chili peppers, especially hotter varieties such as Cayenne and Habanero, can also be used externally as a remedy for painful joints, for frostbite and applied directly to stop bleeding. They stimulate blood flow to the affected area, thus reducing

inflammation and discomfort. Domestic production and economic value: Chilies are grown on an area of 38.4 thousand hectares with production of 90.4 thousand tones, with an average yield of 1.7 tons per hectare with 1.5 per cent share in the GDP. Sindh is the major producer of chilies followed by Punjab and Balochistan. Pakistan earned Rs. 1.127 billion during 2003-2004 by exporting red chili powder, whereas, export earnings from all fruits were Rs. 5.912 billion during the same period. This reveals the potential of this non-staple crop. Despite its importance the yield has declined from 86.5 (1994-95) to 55.8 thousand tons (2003-04). This decline in yield is due to a number of factors including poor quality seed, mal-cultural practices and diseases like viruses, collar rot and phytophthora root rot.

World market for chilies: India is the largest producer of chilies in the world contributing 25 per cent of the total world production, of which only four per cent is exported because of high domestic consumption. Besides India, other major producers and exporters are China, Pakistan, Morocco, Mexico and Turkey. Major importers of chilies from Pakistan are Gulf States, the US, Canada, Sri Lanka, the UK, Singapore and Germany.

Aflatoxin and chemical residues are two major constraints in the export of chilies to Europe, Japan and the US as buyers expect a high degree of hygiene and sanitation in processing and preparing chilies for export.

In Indonesia, chili-planted area is the highest among other vegetables despite the production of cabbage is highest.

Export of red dried chilies from Pakistan has declined from Rs. 1.127 billion (during 2003-2004) to Rs. 846 million after European Union food authorities have detected the presence of aflatoxin (PHDEB). Off-season production technology to extend production season of the crop for about two to three months is evolved.

Disease-free seeds should be used by treating them with suitable fungicide like thiram or captan. During nursery raising, proper cultural practices should be adopted particularly the maintenance of proper soil moisture to avoid phytophthora root rot and collar rot. While after transplanting, proper insect pest control measures should be carried out to check the population of sucking insects, which are the vector for viral diseases affecting the chili crop.

To reduce aflatoxin contamination, some precautionary measures should be adopted. These include: picking and drying of fruit with pedicel (fruit stalk), avoid direct contact of fruit with soil, proper drying of fruit and storage of powder at low relative humidity and temperature. Furthermore, agronomic factors that may influence aflatoxin development like stresses, irrigation, cropping pattern, variety, date of planting, date of harvesting and storage conditions, should be studied in detail.

Chili Cultivation season:

Chili season begins in September and lasts till the middle of March. It is a simpler crop to cultivate. It adjusts itself in various types of soil and different climatic conditions. It gives quality production when it is cultivated on deep, loamy and fertile soil with balanced moisture content. It is a short span crop. For successful growth of chili crop, proper watering and harvesting is essential.

The integrated pest management (IPM) has been evolving over the decades to address the deleterious impacts of synthetic chemical pesticides on environment ultimately affecting the interests of the farmers. The health of a plant is determined by its environment which includes physical factors (i.e. soil, rain, sunshine hours, wind etc.) and biological factors (i.e. pests, diseases

and weeds). All these factors

can play a role in the balance which exists between herbivore insects and their natural enemies. Understanding the intricate interactions in an ecosystem can play a critical role in pest management.

Farmers have to make timely decisions about the management of their crops. However, as field conditions continue to change and new technologies become available, farmers need to continue improving their skills and knowledge. Farmer should monitor the field situation **at least** once a week (soil, water, plants, pests, natural enemies, weather factors etc.)

Description of Insect Pests of Chili

1. Gram Pod Borer (*Helicoverpa Armigera*)

It is a polyphagous pest and the peak activity is noticed during October to June month in chili ecosystem.

Biology:

Egg: The spherical, yellowish eggs are laid singly on tender parts and buds of plants. The egg period lasts for 2-4 days.

Larva: Caterpillars vary in colour, initially brown and later turn greenish with darker broken lines along the side of the body.

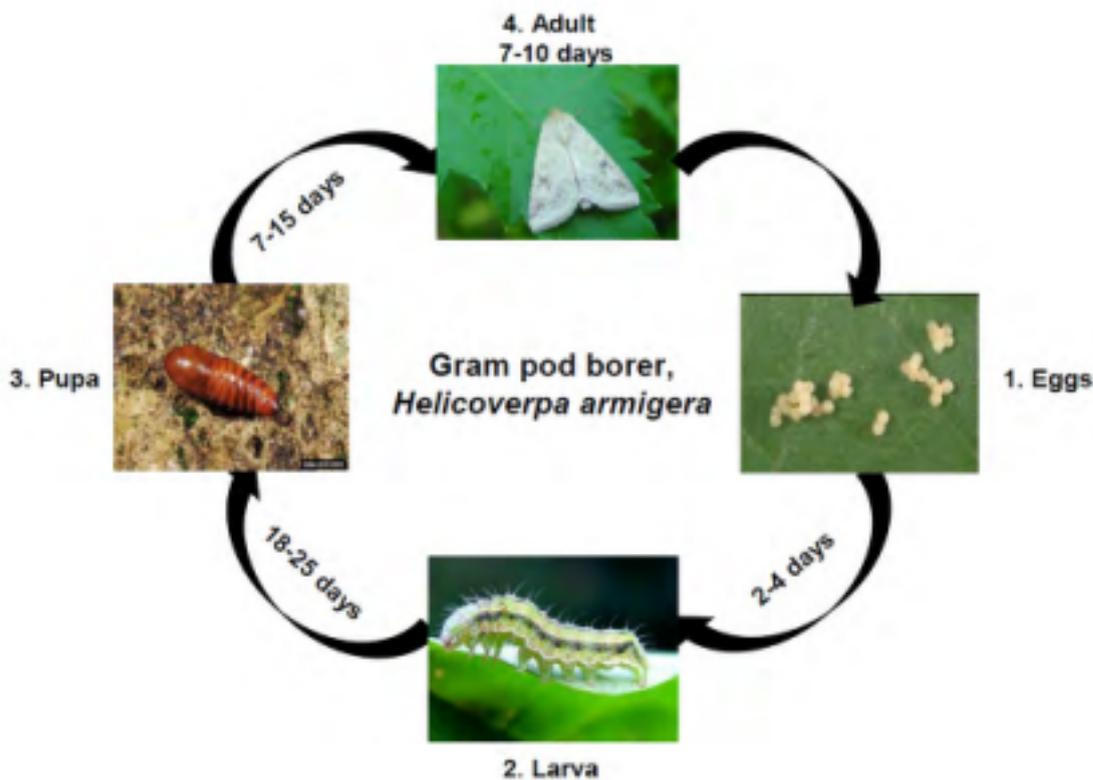
The larval period lasts for 18-25 days. Body covered with radiating hairs. When full grown, they measure 3.7 to 5 cm in length.

The full grown caterpillar pupates in the soil in an earthen cell and emerges in 16-21 days.

Pupa: Pupation takes place inside the soil. Pupal stage lasts 7-15 days.

Adult: Moth is stout, medium sized with brownish/greyish forewings with a dark cross band near outer margin and dark spots near costal margins, with a wing expanse of 3.7cm.

Life Cycle:



Damage Symptoms:

• Young larva feeds on the leaves for some time and then attacks fruits. Internal tissues are eaten severely and completely hollowed out. While feeding the caterpillar thrusts its head inside leaving the rest of the body outside.

• Bored fruits with round holes.

• Fed leaves, shoots and buds.

Management

• Choose a tolerant variety.

• Keep a minimum distance between your plants at sowing. • Avoid to over-irrigate the fields as this would favor the pest. • Monitor your plants frequently and check for the presence of larva. • Collect and destroy the infected fruit and grown up larva. • Spray any one of the following insecticides

Insecticide Dose

Emamectin benzoate 5% SG 4 g/10 lit

Flubendiamide 20 WDG 6 g/10 lit

Indoxacarb 14.5% SC 6.5 ml/10 lit Novaluron 10% EC 7.5 ml/10 lit Spinosad 45% SC 3.2 ml/10 lit Thiodicarb 75%WP 2 g/10 lit

2. Tobacco Caterpillar (*Spodoptera litura*)

It is found throughout the tropical and sub-tropical parts of the world, wide spread in India. Besides tobacco, it feeds on cotton, castor, groundnut, CHILLI, cabbage and various other cruciferous crops.

Biology:

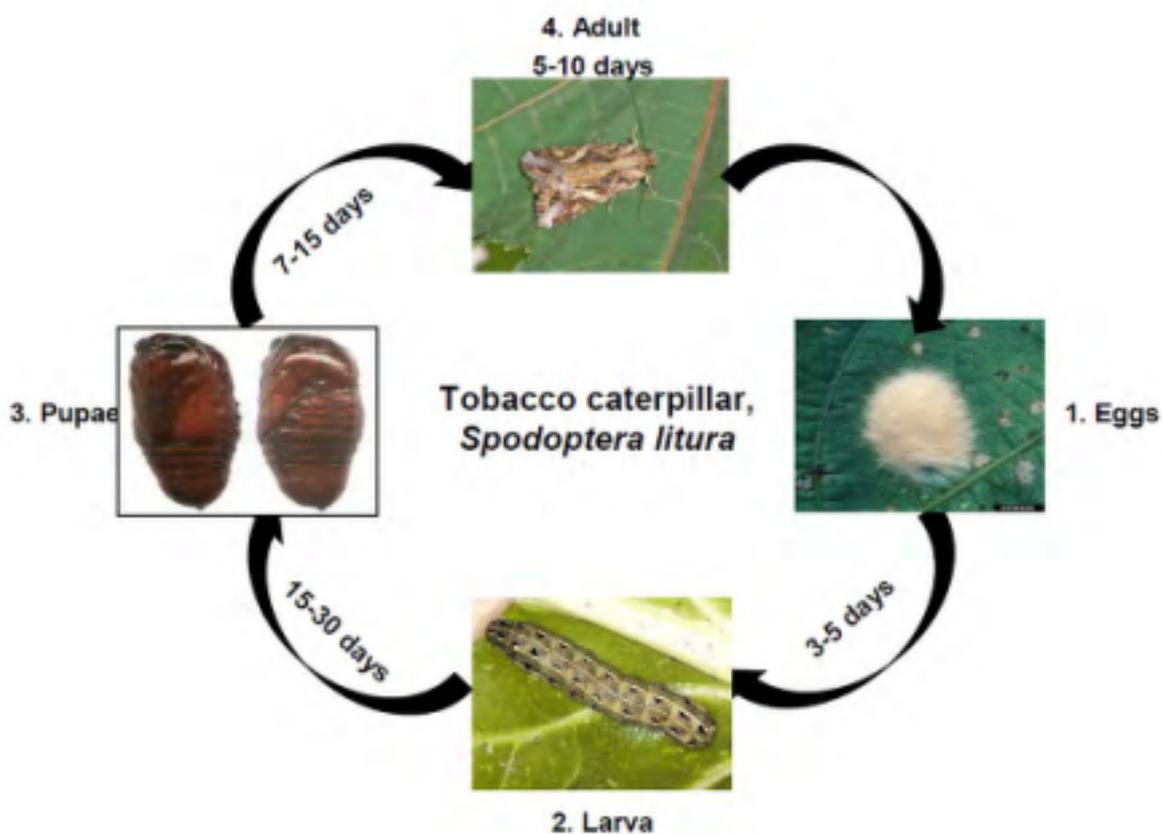
Eggs: Female lays about 300 eggs in clusters. The eggs are covered over by brown hairs and they hatch in about 3-5 days.

Larva: Caterpillar measures 35-40 mm in length, when full grown. It is velvety, black with yellowish – green dorsal stripes and lateral white bands with incomplete ring – like dark band on anterior and posterior end of the body. It passes through 6 instars. Larval stage lasts 15-30 days.

Pupa: Pupation takes place inside the soil. Pupal stage lasts 7-15 days.

Adult: Moth is medium sized and stout bodied with forewings pale grey to dark brown in colour having wavy white crisscross markings. Hind wings are whitish with brown patches along the margin of wing.

Life cycle:



Damage Symptoms:

- Pest breeds throughout the year.
- Moths are active at night.
- Adults live for 7-10 days. Total life cycle takes 32-60 days.
- There are eight generations in a year.
- Small holes on leaves. Skeletonized leaves and the affected pods drop off or develop white color on drying.

Management:

- Plough the soil and expose to sun to kill the Pupae.

- Collect and destroy the egg masses, gregarious larvae and grown up caterpillars. • Set up Pheromone trap
- Use poison bait pellets prepared with rice bran 12.5 kg, jaggery 1.25 kg, Carbaryl 50% WP 1.25 kg and water 7.5 litres and spread in the fields in the evening hours so that the caterpillars coming out of the soil feed and get killed.
- Spray Lufenuron 5% EC at 1 ml/ lit or Novaluron 10% EC at 1 ml/lit
- Spray Chlorpyrifos 2.5 ml/lit of water or Quinalphos 2 ml/lit of water.

3. Spider Mites (*Tetranychus urticae*)

Spider mites are less than 1mm (0.04 inch) in size and vary in color. They lay small, spherical, initially transparent eggs and many species spin silk webbing to help protect the colony from predators. They get the 'spider' part of their common name from this webbing.

Biology:

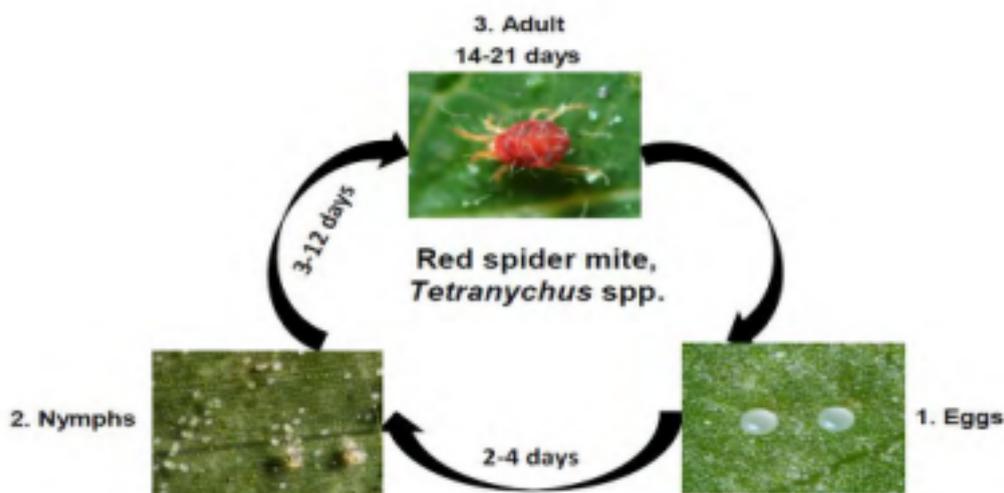
Eggs: Overwinter under bark, in fallen leaf matter, and other areas that provide shelter. During the growing season they can be found on the undersides of leaves. They usually hatch within three days. **Larva:** Begin hatching after the last frost has passed and have six legs. Little feeding is done by this stage.

Nymph: Looks similar to the adult, but slightly smaller and unable to reproduce. There are two nymph stages: proto-nymph and deuto-nymph.

Adult: About 0.4 mm long with eight legs, adult **spider mites** can be pale yellow to green or orange to brown. Females lay between 50-100 eggs throughout their lives with unfertilized eggs hatching as males and fertilized eggs hatching as females.

Life Cycle:

Life cycle (*Tetranychus spp.*):



Damage Symptoms:

- The infested leaves develop crinkles and curl downwards

- Elongated petiole
- Buds become brittle and drop down.
- Early stage, infestation leads to stunted growth and flower production, fruit set are arrested



Management:

- Chemical pesticide use actually encourages the spread of spider mites by killing the beneficial insects that prey on them. Mites are also known to develop quick resistance to various pesticides. For these reasons, it's important to control mites with effective natural and organic methods.
- Prune leaves, stems and other infested parts of plants well past any webbing and discard in trash (and not in compost piles). Don't be hesitant to pull entire plants to prevent the mites spreading to its neighbors.
- Existing spider mite populations should be treated with organic knockdown sprays if allowed. Naturally derived insecticide sprays like Neem Oil, Pyrethrins, Azadirachtin and Horticultural Oil can be sprayed directly onto adult mites, larvae, nymphs and eggs to kill on contact. Apply to active spider mite infestations at 3-day intervals until control is achieved.

4. Thrips(Scirtothrips dorsalis):

It is a pest of economic significance with a broad host range, with prominent pest reports on crops including pepper, mango, citrus, strawberry, grapes etc. Chili thrips appear to feed preferentially on new growth and infested plants usually develop characteristic wrinkled leaves, with distinctive brown scarring along the veins of leaves.

Biology:

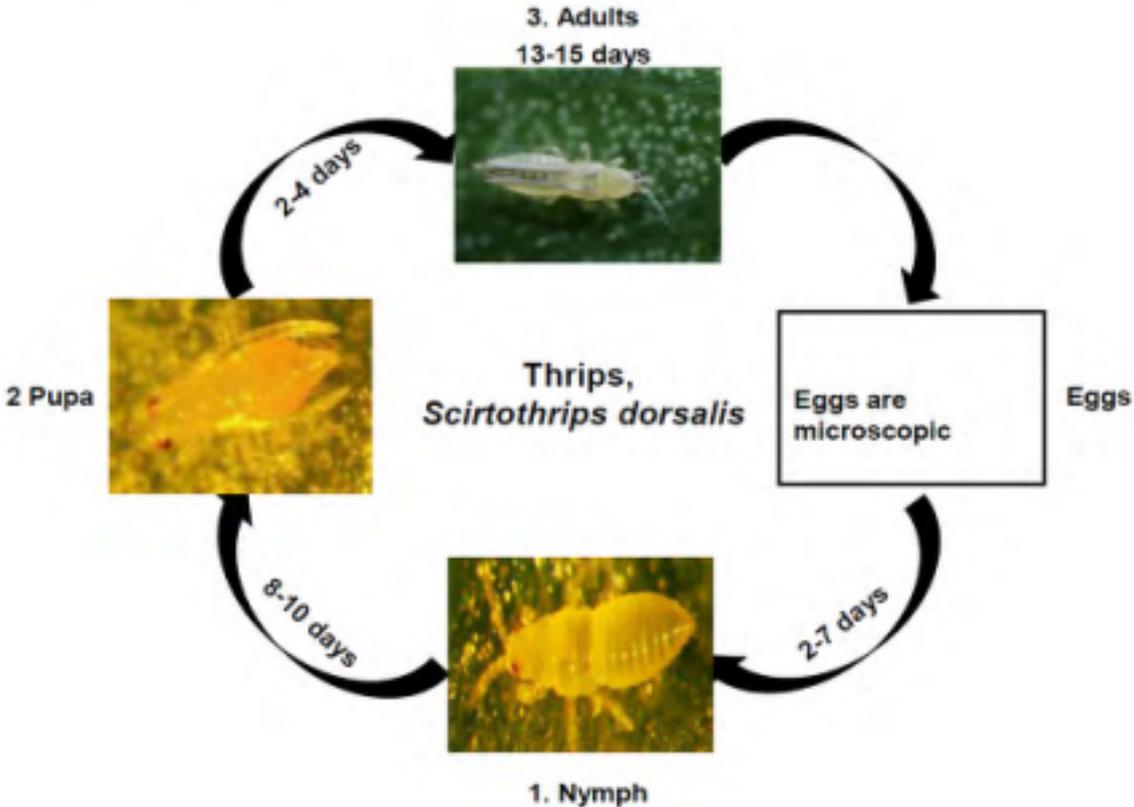
Egg: Hyaline, globular laid in mass.

Nymphs: Nymphs tiny, slender, fragile and straw yellow in color.

Adult: Adults with heavily fringed wings

Life Cycle:

1. Eggs are microscopic



Damage Symptoms:

- The infested leaves curl upward, crumble and shed
- Infested buds become brittle and drop down.
- Affected fruits show light brown scars
- Early stage, infestation leads to stunted growth and flower production, fruit set are arrested

Host-range and favourable conditions:

• *S. dorsalis* is found in almost all chilly growing areas. It is a polyphagous pest. Besides chilli, it also infests brinjal, cotton, groundnut, castor, bottlegourd, guava, tea and grapevine. It is more common on un-irrigated chilli crop than irrigated one.

Upward Curling

Plant shows stunted growth and elongation of petiole

Management:

- Select resistant varieties, if available.
- Use sticky traps to monitor thrips population.
- Remove heavily infested plants from the field.
- Keep the soil well irrigated and avoid excessive nitrogen fertilizer application. • Remove weeds in the and around the field which might act as a hosts.
- Always consider an integrated approach with preventive measures together with biological treatments if available. Foliar sprays containing Malathion are recommended for thrips. • Apply neem oil, spinetoram or spinosad to both sides of the leaves and around the plant's base. • Avoid overuse of insecticides to preserve population of beneficial insects.

5. Aphids (Aphidoidea)

They are small, soft-bodied insects that can survive in almost any zone. Aphids multiply quickly, so it's important to get them under control before reproduction starts. Many generations can occur in one season. The good news is that they tend to move rather slowly and aphid control is relatively easy.

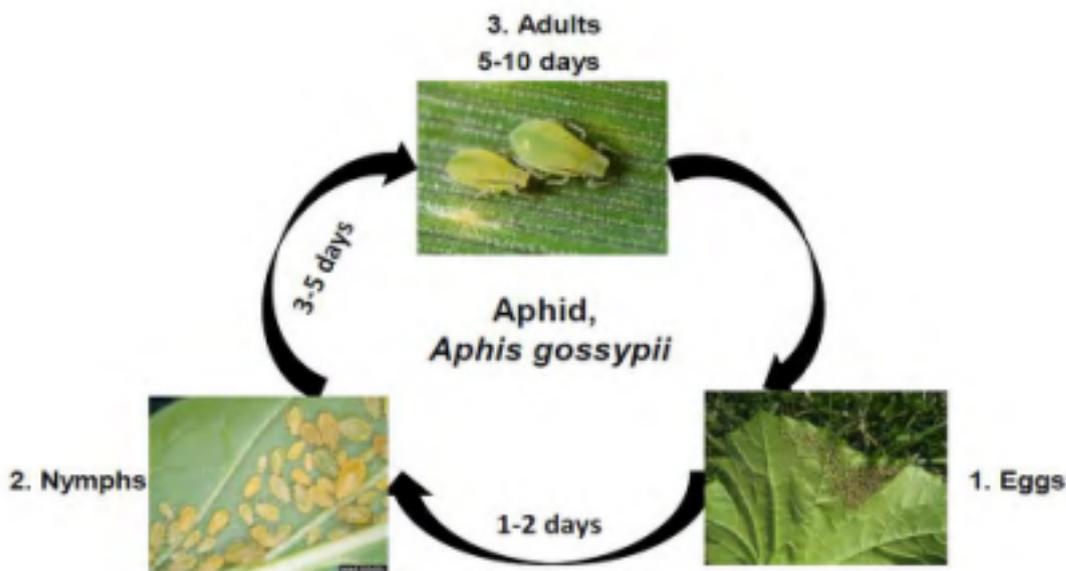
Biology:

Eggs are very tiny, shiny-black, and are found in the crevices of bud, stems, and barks of the plant. Aphids usually do not lay eggs in warm parts of the world.

Nymphs (immature stages) are young aphids, they look like the wingless adults but are smaller. They become adults within 7 to 10 days.

Adults are small, 1 to 4 mm long, soft-bodied insects with two long antennae that resemble horns. Most aphids have two short cornicles (horns) towards the rear of the body

Life Cycle:



Damage Symptoms:

- Appear on the tender shoots, leaves and on the lower surface of the leaves. • The honeydew is very sweet which attracts sooty mould growth, making the leaves turn black. • Suck the sap and reduce the vigour of the plant.
- Secrete sweet substances which attracts ants and develops sooty mould.
- The pods that develop black color due to sooty mould lose quality and fetch low price.
- The yields are also reduced by aphids directly and more through the spread of virus diseases acting as vectors indirectly

Management:

- Try spraying cold water on the leaves. Sometimes all aphids need is a cool blast to dislodge them. Typically they are unable to find their way back to the same plant.
- If you have a large aphid population, dust plants with flour. It constipates the pests. • Neem oil, insecticidal soaps, and horticultural oils are effective against aphids. Be sure to follow the application instructions provided on the packaging.
- Insecticides containing cypermethrin, chlorpyrifos or flonicamid can be used as foliar sprays at 30, 45, 60 days after sowing to control this pest.

Description of plant Diseases

1. Damping off: *Pythium aphanidermatum*

Damage symptoms:

Disease of nursery beds and young seedlings resulting in reduced seed germination and poor stand of seedlings.

Very high seedling mortality 25-75%

- **Pre-emergence** damping off: Seedlings disintegrate before they come out of soil surface leading to poor seed germination
- **Post-emergence** damping off is characterized by development of disease after seedlings have emerged out of soil but before the stems are lignified
- **Water soaked lesion** formation at collar region
- Infected areas turn **brown and rot**
- Plants shrivel and **collapse** as a result of softening of tissues
- In *Rhizoctonia solani* attack infected stems become hard, thin (**wire stem** symptoms) and infected seedlings topple Disease appear in patches both in nursery and field beds.

Survival and spread:

Primary: Oospores in soil in case of *Pythium*

Sclerotia in soil in case of *Rhizoctonia*

Secondary: Zoospores through irrigation water in case of *Pythium*. Mycelial growth in soil and sclerotia through irrigation water in case of *Rhizoctonia*.

Favorable conditions:

Heavy rainfall, excessive and frequent irrigation, poorly drained soil and close spacing, high soil moisture with temp around 25-30 °C

For *Rhizoctonia*: High soil moisture with temp around 30 – 35 °C.

Management:

- Use seeds from Healthy plants or from certified sources.
- Avoid excessive moisture by soil drainage.
- Avoid too frequent irrigation during the vegetative growth of the crop.
- Bio-fungicides based on the bacteria *Bacillus subtilis* can be used to control the transmission of the disease.
- In fields with histories of damping-off or problems with drainage consider using fungicides preventively. For example, the seeds can be treated with ceresin or with 1% Bordeaux mixture.

2. Die-back Anthracnose (fruit rot): *Colletotrichum spp*

Damage Symptoms:

- Disease is more in December - October in transplanted crop
- Small, circular to irregular, brownish black scattered spots appear on leaves • Severely infected leaves defoliate
- Infection of growing tips leads to necrosis of branches from tip backwards • Necrotic tissues appear grayish white with black dot like acervuli in the center • Shedding of flowers due to the infection at pedicel and tips of branches
- Fruit symptoms
- Ripe fruits are more vulnerable to attack than green ones

- Small, circular, yellowish to pinkish sunken spots appear on fruits
- Spots increase along fruit length attaining elliptical shape
- Severe infection result in the shrivelling and drying of fruits.
- Tissues around lesions will be bleached and turn white or greyish in color and lose their pungency
- On the surface of the lesions minute black dot like fruiting bodies called 'acervuli' develop in concentric rings and fruits appear straw colored
- The affected fruits may fall off subsequently. The seeds produced in severely infected fruits are discolored and covered with mycelial mat.

Survival and spread:

Primary: Mycelium and conidia in acervuli in infected seeds and diseased crop debris. **Secondary:** Conidia dispersed by rain splash and wind.

Favourable conditions:

Temp, 28 °C with RH more than 97%, humid weather with rainfall at frequent intervals, intercropping with turmeric which is another host of the fungus

Management:

- Use of resistant varieties not only eliminate the losses from diseases, but also eliminate chemical and mechanical expenses of disease control.
- Pathogen-free chili seeds should be planted and weeds eliminated. Crops should be rotated every 2-3 years with crops that are not alternative hosts of *Colletotrichum*.
- The field should have good drainage and be free from infected plant debris. • Chemicals are most common and practical method to control anthracnose diseases. The fungicide traditionally recommended for anthracnose management in chili is Manganese ethylenebisdithiocarbamate although it does not consistently control the severe form of the disease.
- The strobilurin fungicides azoxystrobin, trifloxystrobin and pyraclostrobin have recently been labeled for the control of Anthracnose of chili.

3. Mosaic complex:

Damage Symptoms:

Symptoms vary with the virus **TMV**

- Raised blisters and mottled areas of light and dark green areas on the foliage • Leaves point towards ground
- Necrotic spots on stem
- Fruit ripens unevenly and is reduced in size **CMV**
- Reduction in leaf size and narrowing of lamina Chlorosis leading to mosaic symptoms • Downward curling along with midrib
- Fruit may be small and distorted, on volunteer CHILLI plants and on infected plant debris.

Disease symptoms on plant foliage

Survival and spread:

TMV:

Primary: Externally seed borne virus particles

Secondary: Mechanically transmitted virus particles.

CMV:

Primary: Externally seed borne virus particles to some extent and vector transmitted from other and collateral hosts

Secondary: Virus particles transmitted by aphid vectors, *Myzus persicae*, *Aphis gossypii*, *A. craccivora* **Favorable conditions:**

- Moist weather and splattering rains
- High humidity or persistent dew

Management:

- There are no cures for viral diseases such as mosaic once a plant is infected. As a result, every effort should be made to prevent the disease from entering the field.
- Fungicides will not treat this viral disease.
- Use the resistant varieties when available.
- Do not save seed from infected crops.
- The virus can be spread through human activity, tools and equipment. Frequently wash your hands.
- Avoid working in the garden during damp conditions. Avoid using tobacco around susceptible plants. Cigarettes and other tobacco products may be infected and can spread the virus
- Remove and destroy all infected plants. Do not compost.

4. Powdery Mildew: *Leveillula taurica*

Damage Symptoms:

- White powdery coating appears mostly on the lower surface and occasionally on upper surface
- Correspondingly on the upper surface yellow patches are seen
- Severe infection results in the drying and shedding of affected leaves

- Powdery growth can also be seen on branches and young fruits
- Diseased fruits do not grow further and may drop down prematurely

Survival and spread:

Primary: Dormant mycelium in the infected crop debris **Secondary:** Wind dispersed conidia

Favorable conditions:

- Cool dry weather favors conidial germination • High RH favors disease development

Management:

- Use resistant or tolerant varieties
- Remove infected leaves when the first spot appear. Do not touch healthy plants after touching the infected plants.
- In view of the number of crops that are susceptible to powdery mildew, it is difficult to recommend any particular chemical treatment. Fungicides based on wettable Sulphur, triflumizole, myclobutanil seem to control the growth of fungus.

5. Cercospora Leaf Spot: *Cercospora Capsici*

Damage Symptoms:

- Circular spots with brown margins and grey centre appear on leaves
- The spots enlarge and coalesce with others
- The central portion of the spot becomes white and the leaves turn yellow and defoliate • Sometimes central portion of spot drops off
- Spots also appear on stems and twigs as dark brown, irregular lesions with whitish centers • In severe cases die-back of twigs occur

Survival and spread:

Primary: Dormant mycelium in the infected crop debris, seeds and volunteer plants **Secondary:** Wind dispersed conidia

Management:

- Use healthy and certified seeds.
- Use stakes to keep plants upright.
- Monitor seedbeds, young plants or transplants for any disease symptoms.
- Remove the infected plants and destroy them away from the field.
- Seed treatment with captan 3g/kg works fine to fight the disease.
- Other treatments to control this disease include foliar spray of products containing copper hydroxide, chlorothalonil or mancozeb. Treatment should start when the spots appear and continue at 10-14 days intervals until 3-4 weeks before last harvest. It is important to spray both sides of the leaves.

6. Bacterial Leaf Spot: *Xanthomonas campestris pv. Vesicatoria*

Damage Symptoms:

- Leaves, fruits and stems are affected
- Lesions on leaf begin as circular, water soaked spots • Spots become necrotic with brown center with chlorotic borders • Enlarged spots may develop straw colored centers
- Lesions are slightly raised on lower leaf surface
- Severely spotted leaves turn yellow and drop
- Raised brown lesions appear on fruits
- Narrow elongated lesions or streaks may develop on stems

Survival and spread:

Primary: Seed borne bacterial cells

Secondary: Bacterial cells spread by rain splash

Favorable conditions:

- Moderate temperature
- High relative humidity
- Intermittent rains

Management:

- The use of disease free seed and transplants is important for the early control of the Bacterial leaf spot.
- Avoid using overhead irrigation.

- Copper sprays can provide moderate levels of protection, but must be sprayed as a preventive and not a curative.
- Spray mancozeb 1ml/10 lit of water at 14 day intervals
- Spray regularly if prolonged wet weather occurs.

7. Alternaria Leaf Spot: *Alternaria solani*

Damage Symptoms:

- This is a common disease occurring on the foliage at any stage of the growth. • The fungus attacks the foliage causing characteristic leaf spots and blight. Early blight is first observed on the plants as small, black lesions mostly on the older foliage.
- Spots enlarge, and by the time they are one-fourth inch in diameter or larger, concentric rings in a bull's eye pattern can be seen in the center of the diseased area.
- Tissue surrounding the spots may turn yellow. If high temperature and humidity occur at this time, much of the foliage is killed.
- Lesions on the stems are similar to those on leaves, sometimes girdling the plant if they occur near the soil line.
- Transplants showing infection by the late blight fungus often die when set in the field. The fungus also infects the fruit, generally through the calyx or stem attachment.
- Lesions attain considerable size, usually involving nearly the entire fruit; concentric rings are also present on the fruit.

Disease symptoms on leaf and fruit

Survival and spread:

Primary: The fungus spends the winter in infected plant debris in or on the soil where it can survive at least one and perhaps several years. It can also be seed borne.

Secondary: The spores are transported by water, wind, insects, other animals including man, and machinery. Once the initial infections have occurred, they become the most important source of new spore production and are responsible for rapid disease spread.

Favourable conditions:

- Warm, rainy and wet weather

Management:

- Prune or stake plants to improve air circulation and reduce fungal problems. • Apply copper-based fungicides early, two weeks before disease normally appears or when weather forecasts predict a long period of wet weather. Alternatively, begin treatment when disease first appears, and repeat every 7-10 days for as long as needed.
- Remove and destroy all the debris after the harvest. Burn or bag infected plant parts. Do not compost.

8. Fusarium Wilt: *Fusarium Solani*

Damage Symptoms:

- The first symptom of the disease is clearing of the veinlets and chlorosis of the leaves. • The younger leaves may die in succession and the entire may wilt and die in a course of few days. Soon the petiole and the leaves droop and wilt.
- In young plants, symptom consists of clearing of veinlet and dropping of petioles. In field, yellowing of the lower leaves first and affected leaflets wilt and die.
- The symptoms continue in subsequent leaves. At later stage, browning of vascular system occurs. Plants become stunted and die.

Survival and spread:

- Soil and implements

Favorable conditions:

- Relatively high soil moisture and soil temperature

Management:

- Use resistant varieties if available.
- High nitrogen fertilizers may increase susceptibility to the disease. Test your soil and use a slow release organic fertilizer.
- Trichoderma viride and also be used to treat the seeds (10g/kg).
- Mycostop is a biological fungicide that will safely protect crops against wilt caused by *Fusarium*. • Apply soil based fungicides on contaminated locations if no other measures are effective. Drenching the soil with copper oxychloride at 3g/Liter of water

before sowing/transplanting is also effective.

9. Sclerotium Rofsii: *Athelia rofsii*

Damage Symptoms:

- Development of coarse white strands of mycelium growing in a fan-shaped pattern on lower stems, leaf litter, and soil.
- Early symptoms consist of water-soaked lesions on crown and lower stem tissue. • Disease usually is recognized by the yellowing and wilting of foliage, followed by a complete collapse of the plant.
- Fruit and other fleshy organs near the soil surface may become infected with *S. rofsii*. • Soft, water-soaked, sunken, slightly yellowish lesions develop. These lesions quickly spread throughout most or all of the fruit, which will eventually become soft and collapse within 3 to 4 days of infection.





Favorable conditions:

- The disease occurs worldwide, but predominantly in warm climates.

Management:

- Avoiding the disease by selecting fields that are free of *S. rolfsii* is the most successful method of control.
- Certain fertilization regimes, such as high calcium levels and ammonium type fertilizers, may suppress disease under low disease pressure. Certain non-acidifying fertilizers such as calcium nitrate can be used to prevent acidifying soil and creating conditions conducive to disease development.
- Fungicide applications can be used to manage southern blight. Most fungicides are labeled for use on select ornamentals, vegetables, and some field crops.
- Fumigants are toxic to sclerotia and mycelium in the soil. However, even after fumigation, some sclerotia survive, and treatments must be repeated annually.

Do's and Don'ts in IPM

No.	Do's	Don'ts
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1.	Deep ploughing is to be done on bright sunny days during the months of May and June. The field should be kept exposed to sun light at least for 2-3 weeks	Do not plant or irrigate the field after ploughing, at least for 2-3 weeks, to allow desiccation of weed's bulbs and/or rhizomes of perennial weeds.
2.	Adopt crop rotation.	Avoid growing monocrop.
3.	Grow only recommended varieties.	Do not grow varieties not suitable for the season or the region.
4	Sow early in the season	Avoid late sowing as this may lead to reduced yields and incidence of white grubs and diseases.
5	<p>Always treat the seeds with approved chemicals/bio products for the control of seed borne diseases/pests.</p> 	Do not use seeds without seed treatment with biocides/chemicals.

6.	<p>Sow in rows at optimum depths under proper moisture conditions for better establishment.</p> 	Do not sow seeds beyond 5-7 cm depth.
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7.	Apply only recommended herbicides at recommended dose, proper time, as appropriate spray solution with standard equipment along with flat fan or flat jet nozzles.	Pre-emergent as well as soil incorporated herbicides should not be applied in dry soils. Do not apply herbicides along with irrigation water or by mixing with soil, sand or urea.
8.	Maintain optimum and healthy crop stand which would be capable of competing with weeds at a critical stage of crop weed competition.	Crops should not be exposed to moisture deficit stress at their critical growth stages.
9	Use NPK fertilizers as per the soil test recommendation.	Avoid imbalanced use of fertilizers.
10	Use micronutrient mixture after sowing based test recommendations.	Do not apply any micronutrient mixture after sowing without test recommendations.
11	Install pheromone traps at appropriate Period.	Do not store the pheromone lures at normal room temperature (keep them in refrigerator).
12	In case of pests which are active during night like <i>Spodoptera</i> spray recommended biocides/ chemicals at the time of their appearance in the night.	Do not spray pesticides at midday since, most of the insects are not active during this period.
13	Spray pesticides thoroughly to treat the undersurface of the leaves, particularly for mites, whiteflies, <i>Spodoptera</i> etc.	Do not spray pesticides only on the upper surface of leaves.

Plantix:

Plantix is an android mobile crop advisory app for farmers, agriculture extension officers and gardeners. It can diagnose plant diseases, pest damages and nutrient deficiencies affecting crops and offers corresponding treatment measures by processing a

plant damage symptom image taken by a smart phone. Users can participate in the online community to network with other farmers, discuss plant health issues and access their local weather reports. Plantix was developed by PEAT GmbH, a Berlin based Artificial Intelligence startup. PEAT partner ICRISAT customized Plantix for local crops in India through a consortium of partners like state agricultural universities in India.

Plantix app is able to identify the plant type as well as the appearance of a possible disease, pest or nutrient deficiency. Plantix takes advantage of [deep learning technology](#) which involves [neural networks](#). Furthermore, it provides information on treatment and preventive measures. From the daily new images sent by Plantix users worldwide, the network constantly learns more. This permanent incoming data stream is the basis to providing Plantix users with up-to-date information and alerts in terms of plant diseases, pests and their worldwide distribution in real time.

Plantix already cooperates with international research institutes and inter-governmental organizations such as [ICRISAT](#), [CIMMYT](#) and [CABI](#). The Agriculture and Horticulture Department of the Government of [Andhra Pradesh](#), India has already integrated Plantix into its extension services. Plantix preview (beta version) can be freely downloaded from google play store from around the world. Details of this innovative plant protection advisory app can be found at www.plantix.net

[Acknowledgements:](#)

[Study material has been compiled from:](#)

1) Agro-Eco Systems Analysis (AESAs) based IPM – Chilies/Capsicum by Department of Agriculture and Cooperation, Ministry of Agriculture, Government of INDIA. 2) Plantix